

The percentage of residue obtained was corrected for the minor non-volatile constituents, as follows: Na₂O, 0.21 per cent; MgO, 0.13 per cent; nonvolatile insoluble matter, 0.06 per cent, and SO₃ retained in the residue, 0.10 per cent; the sum of which is 0.50 per cent.

BOTANY.—*On the species of Dalbergia of Mexico and Central America.*
H. PITTIER.¹

As considered in the light of modern taxonomy, the genus *Dalbergia* includes the former genera *Amerimnon* and *Ecastophyllum*. There is no generic difference between *Amerimnon*, established by Browne in 1756 to include *Dalbergias* with samaroid pods, and *Ecastophyllum* of the same author and date, containing the species with nummular pods. On the other hand, on the evidence of the generic definition, the species of *Amerimnon* do not fit into *Ecastophyllum*, and species of *Ecastophyllum* cannot come under *Amerimnon*.

In 1781, Linnaeus filius described his new genus *Dalbergia*, which under both the International and the American Rules would not be valid, but for the fact that neither of the two names having the priority really represents a generic entity, but only one part of a single genus, while the later name was intended to apply to both parts.

In this paper, therefore, in accordance with the well founded conclusions given by Prain² in his extensive monograph "*The Species of Dalbergia of South Eastern Asia*," the name *Dalbergia* is retained to designate the genus; *Amerimnon* becomes the name of a subgenus, while the species of *Ecastophyllum* are transferred to a single section of the same. This is the view accepted by all European botanists and, I believe, by the majority of those on this side of the Atlantic. In all the recent literature on the subject, including the description of a large number of species old and new, the same name is used, so that the resuscitation of *Amerimnon* as a substitute for *Dalbergia* would cause a great and useless confusion, even omitting the fact that it cannot be applied to the genus as understood today.

In its original form, the present paper included full descriptions of all Mexican and Central American species. Circumstances now have made it necessary to suppress the descriptions of old species and to reduce the paper to a simple enumeration of them, with their known distribution, and to descriptions of only the proposed new species. In addition, the following key has been prepared.

¹ Received December 15, 1921.

² Ann. Bot. Gard. Calc. 10: 10-11. 1904.

KEY TO THE MIDDLE AMERICAN SPECIES OF DALBERGIA

Standard blade straight or hardly reflexed; style short and thick (*Sissoa*).

Leaflets ovate or oblong-lanceolate, rather large (3 to 11 cm. long); stamens 9.

Flowers about 5.5 mm. long, the standard obovate, subauriculate at the base; leaflets 3 to 8 cm. long, 1.5 to 2.5 cm. broad.

Flowers about 3.5 mm. long, the standard ovate or oblong, attenuate at the base; leaflets 4 to 11 cm. long, 2 to 5 cm. broad.

Leaflets ovate or ovate-long, rather small (seldom over 4 cm. long); stamens 9 or 10. Stamens 9.

Inflorescences loose, dichotomous-paniculate; flowers about 4 mm. long; leaflets ovate, obtuse or subacuminate. Ovary 1-ovulate; standard suborbiculate.

Inflorescences congested, cymose-paniculate.

Flowers 3 to 3.5 mm. long; ovary glabrous, 2 or 3-ovulate; leaflets 3 to 5 cm. long.

Flowers about 5.5 mm. long; ovary hairy, 1 or 2-ovulate; leaflets 0.5 to 3 cm. long.

Stamens 10.

Pistil glabrous.

Ovary 4 or 5-ovulate; wings narrow, elongate, the base of the blade truncate, 2-auriculate; leaflets oblong or obovate, whitish and ruforeticulate beneath.

Ovary 1 or 2-ovulate; wings oblique, obovate, 1-auriculate; leaflets ovate, emarginate, ferruginous-pubescent beneath.

Pistil more or less hairy. Ovary 2 or 3-ovulate.

Flowers 5 mm. long, the pedicels 1 mm. long or less; ovary minutely pubescent; standard subauriculate.

Flowers 10.5 mm. long, the pedicels 2.5 to 3.5 mm. long; ovary hairy on the margins; standard attenuate at the base.

Standard blade reflexed (with one exception, *D. brownii*, but then leaves 1-foliolate); style slender, often subulate (*Amerimnon*).

1. *D. cubilquitzensis*.

2. *D. tucurensis*.

3. *D. melanocardium*.

4. *D. glomerata*.

5. *D. congestiflora*.

6. *D. tabascanana*.

7. *D. cibix*.

8. *D. mexicana*.

9. *D. campecheana*.

- Flowers not over 12 mm. long; style geniculate, short and straight; legume orbicular and 1-seeded, or ovate-oblong and 1 to 3-seeded (*Ecastophyllum*).
- Legume ovate-oblong, rounded at the apex, 1 to 3-seeded; flowers about 11 mm. long; standard obovate, straight; leaves 1-foliolate; stamens 10. 10. *D. brownei*.
- Legume orbicular, 1-seeded; standard orbiculate, reflexed.
- Leaves 1-foliolate; flowers about 10 mm. long; stamens 10. 11. *D. ecastophyllum*.
- Leaves 3 to 5-foliolate; flowers about 6 mm. long; stamens 9. 12. *D. monetaria*.
- Flowers not less than 14 mm. long; style long and strongly arcuate; legume more or less lanceolate, 1 to 5-seeded. Stamens 10 (*Miscolobium*).
- Leaves entirely glabrous, 5 to 7-foliolate, the leaflets 3 to 4 cm. long. 13. *D. calycina*.
- Leaves more or less pubescent, 7 to 15-foliolate.
- Leaves and pods hardly changing color in desiccation; leaflets 7 to 11, ovate, glaucous beneath; legume 1 to 5-seeded, rounded-obtuse at the apex. 14. *D. hypoleuca*.
- Leaves and pods turning black in desiccation.
- Leaflets suborbiculate or broadly ovate, not over 5 cm. long, the margin not revolute. 15. *D. granadillo*.
- Leaflets ovate or oblong, up to 10.5 cm. long, the margins revolute.
- Flowers about 15 mm. long, the pedicels 4 to 5 mm. long; standard suborbiculate, more or less emarginate at the base. 16. *D. retusa*.
- Flowers about 16 mm. long, the pedicels about 5 mm. long; standard ovate or oblong, attenuate at the base. 17. *D. lineata*.

ENUMERATION OF SPECIES

1. *Dalbergia cubilquitzensis* (Donn. Smith) Pittier.

Dalbergia variabilis var. *cubilquitzensis* Donn. Smith, Bot. Gaz. 57: 417. 1914.

TYPE LOCALITY: Cubilquitz, Alta Verapaz, Guatemala, altitude about 350 m. (von Tuerckheim 4091).

OTHER SPECIMENS EXAMINED:

GUATEMALA: Los Amates, Department Izabal, 1905, *Kellerman* 4789.

This species, considered by Mr. Donnell Smith as a mere variety of *D. variabilis* Vogel, differs from this in the pubescence, the shape and size of the

calyx lobes, the shape of the petals, the number of stamens, the shape and size of the leaves and leaflets, etc.

2. *Dalbergia tucurensis* Donn. Smith, Bot. Gaz. 46: 111. 1908.

TYPE LOCALITY: Concepción near Tucuón, Alta Verapaz, Guatemala (*von Tuerckheim* II. 1712).

3. *Dalbergia melanocardium* Pittier, sp. nov.

Medium sized tree; branchlets terete, ferruginous pubescent, later glabrate and grayish.

Leaves 7 to 11-foliolate, the rachis terete, minutely pilosulous, 4 to 13 cm. long. Leaflets subcoriaceous, the petiolules sparsely ferruginous-pubescent, 3 to 4 mm. long, the blades ovate, rounded or subacute at the base, obtuse and subretuse at the apex, 1.5 to 4.5 cm. long, 1.3 to 2.5 cm. broad, dark green and pilosulous above, paler or rufescent, ferruginous-pubescent and reticulate beneath, the very slender veins prominent on both faces.

Inflorescences paniculate, axillary and terminal, congested, shorter than the leaves, the branched rachis ferruginous-pubescent. Bractlets small, ovate or orbiculate, ferruginous-pubescent. Flowers sessile or short pedicellate, about 4 mm. long. Calyx subbilabiate, broad, fulvous-hairy, about 2.5 mm. long, the two vexillar lobes broad and rounded, the 2 lateral ones equally long and obtuse, but narrower, the carinal one about twice longer, obtuse or bilobulate. Petals glabrous; standard suborbiculate, the claw oblique, 0.8 to 0.9 mm. long, the blade subauriculate at the base, emarginate at the apex, about 3 mm. long and broad; wings free from the keel, auriculate on both margins at the base, obtuse at the apex, about 4 mm. long (including the claw) and 1.4 mm. broad; carinal petals broader than the wings, ovate, auriculate on the vexillar side, obtuse, about 3.8 mm. long, 1.5 mm. broad. Stamens 9, monadelphous, the staminal tube glabrous, open above. Pistil 4.5 to 5 mm. long, the ovary stipitate, 1-ovulate, ferruginous-villous, the style thick, arcuate, glabrous, the stigma inconspicuous.

Type in the U. S. National Herbarium, no. 258410, collected at Ojo de Agua, Department of Santa Rosa, Guatemala, altitude about 900 meters, May, 1892, by Heyde and Lux (J. D. Smith 3295).

Known among the natives under the name of "Ebano," and distributed as *Dalbergia variabilis* Vogel. Like this species it has a calyx with two broad more or less connate upper lobes, and three narrower lower lobes, the middle (carinal) one about twice longer, but obtuse or retuse. But the flowers are sessile, shorter and broader, there are 9 stamens, the ovary is densely villous-hairy and the congested inflorescence is not cymose.

4. *Dalbergia glomerata* Hemsl. Diag. Pl. Nov. 1: 8. 1878.

TYPE LOCALITY: Sangolica, Mexico (*Botteri* 1027).

5. *Dalbergia congestiflora* Pittier, sp. nov.

Small tree, 3 to 4 m. high; branchlets terete, striate, sparsely lenticellate, at first minutely grayish-pubescent.

Leaves 7 to 13-foliolate, the rachis slender, sparsely pubescent, 4 to 11 cm. long. Leaflets subcoriaceous, the petiolules pilosulous, 2 to 3 mm. long, the blades ovate-oblong, broadly cuneate at the base, rounded, slightly emarginate and sometimes mucronulate at the apex, 0.5 to 3 cm. long, 0.3 to 2.3 cm. broad, sparsely pilosulous on both faces, reticulate and with the venation prominulous above, beneath lineate-reticulate, the costa and veins prominent.

Inflorescences paniculate, cymose-branched, axillary or terminal on defoliate branchlets, congested, not over 3 cm. long, the rachis densely ferruginous-hairy. Bracts and bractlets oblong, ferruginous-hairy, very small, caducous. Flowers pedicellate, 5.5 mm. long, the pedicels 1 to 1.5 mm. long. Calyx subcampanulate, 2 to 2.5 mm. long, sparsely pubescent, the 2 vexillar lobes broad, rounded and adnate, the lateral lobes narrower and acute, the carinal lobe apiculate and longer. Petals glabrous; standard ovate or oblong, more or less attenuate at the base, emarginate at the apex, 3.6 mm. long, 1.4 to 1.6 mm. broad; wings elongate, oblique, more or less attenuate at the base, rounded at the apex, about 3 mm. long, 0.9 to 1.1 mm. broad; carinal petals ovate, auriculate on the vexillar side, obtuse at the apex, the claw about 0.8 mm. long, the blade about 2.5 mm. long, 1.5 to 1.8 mm. broad. Stamens 9, glabrous. Pistil 2.5 to 3 mm. long, hairy, ciliate on the margins, the ovary 1-ovulate (?), the style short and thick, the stigma inconspicuous.

Type in the U. S. National Herbarium, no. 381855, collected on lava fields near Cuernavaca, Morelos, Mexico, altitude about 1650 m., March 17, 1899, by C. G. Pringle (no. 6981).

Distributed as *Dalbergia glomerata* Hemsley, but the leaves are much smaller, the leaflets less numerous, more than half smaller, pilosulous on both faces, the flowers are larger, the standard is sensibly longer than the wings and keel and not suborbiculate but ovate or distinctly oblong, the ovary is apparently 1-ovulate, etc.

6. *Dalbergia tabascana* Pittier, sp.

Shrub (?); branchlets grayish, sparsely lenticellate, at first minutely grayish-pubescent.

Leaves 6 or 7-foliolate, the rachis slender, minutely pilosulous, 3 to 3.5 cm. long. Leaflets subcoriaceous, the petiolules minutely pubescent, 1 to 1.5 mm. long, the blades oblong or obovate, rounded at the base and apex, 1 to 2.5 cm. long, 0.5 to 1 cm. broad, dark green and glabrous above, whitish or rufescent, rufo-reticulate and minutely pilosulous beneath.

Inflorescences few-flowered, subcymose, axillary or paniculate at the end of the branchlets, the rachis branched, sparsely gray-pubescent. Bracts and bractlets ovate-oblong, pubescent, not over 1 mm. long, caducous. Flowers pedicellate, about 9 mm. long, the pedicels minutely gray-pubescent, 2 to 4 mm. long. Calyx tubular-campanulate, 3.5 to 4 mm. long, sparsely pubescent or glabrescent at the base, pubescent on the lobes, subbilabiate, the carinal lobe apiculate, not much longer than the vexillar ones, these obtuse, the lateral ones smaller and acute. Petals glabrous; standard obovate-oblong, straight, attenuate and subauriculate at base, rounded and slightly emarginate at apex, the claw about 2 mm. long, the blade 5.5 mm. long, 1.6 mm. broad; wings elongate-oblong, auriculate on the vexillar side, subauriculate on the carinal side, rounded at apex, the claw 2 mm. long, the blade about 5.5 mm. long, 1.6 mm. broad; carinal petals falcate, auriculate on the vexillar side, obtuse at the apex, the claw 2.2 mm. long, the blade about 4 mm. long and 1.8 mm. broad. Stamens 10, monadelphous, glabrous, alternately short and long. Pistil about 6 mm. long, glabrous, the ovary long-stipitate, 4 or 5-ovulate, the style oblique, straight, the stigma subcapitellate.

Type in the John Donnell Smith Herbarium, collected in inundated places near Mayito, Tabasco, Mexico, August 17, 1889, by J. N. Rovirosa (no. 583).

The type specimen is labelled *Dalbergia campecheana* Benth., but the leaves are small, with few, distinctly petiolulate leaflets, the inflorescences are few-flowered, the ovary is 4 or 5-ovulate, etc.

7. *Dalbergia cibix* Pittier, sp. nov.

Scandent shrub or vine, ascending to 20 m. above the ground; branchlets terete, grayish, more or less lenticellate, at first densely ferruginous-pubescent.

Leaves 7 to 9-foliolate, the rachis terete, slender, ferruginous-hirtous, 4 to 5 cm. long. Leaflets submembranous, the petiolules ferruginous-pubescent, about 1.5 mm. long, the blades ovate, rounded at the base, rounded and slightly emarginate at the apex, 1 to 2 cm. long, 0.6 to 1.3 cm. broad, sparsely pilosulous and minutely reticulate above, beneath densely ferruginous-pubescent, the costa prominent and the veins impressed; margins revolute.

Inflorescences paniculate, many-flowered, axillary, terminal or more or less fasciculate on defoliated nodes, the rachis branched, ferruginous-hairy. Bracts and bractlets suborbiculate, pubescent, 1 mm. long or less, caducous. Flowers pedicellate, white, about 7 mm. long, the pedicels 1 to 1.5 mm. long. Calyx subtubular, bilabiate, 2.5 to 3 mm. long, sparsely pubescent, the 2 vexillar lobes broad, rounded and adnate, the 2 lateral lobes small and acute, the carinal lobe narrow, acute, twice as long as the others. Petals pink (?), glabrous; standard oblong, hardly auriculate at the base, emarginate, the lobes rounded at the apex, the claw 1.2 mm. long, the blade 5.5 mm. long, 3.3 mm. broad; wings oblique, obovate, auriculate on the vexillar margin at the base, obtuse at the apex, the claw about 1.5 mm. long, the blade 4.5 to 5 mm. long, about 2 mm. broad; carinal petal subfalcate, auriculate on the vexillar side, subacute, the claw as in the wings, the blade 3.2 mm. long, 1.5 mm. broad. Stamens 10, monadelphous, alternately long and short, glabrous. Pistil about 5 mm. long, glabrous, the ovary stipitate, 1 or 2-ovulate, the style slightly arcuate, truncate at the apex.

Legume ovate-oblong, membranous, attenuate at the base in a short, slender stipe, rounded at the apex, 1-seeded, 4.5 to 6 cm. long, 1.5 to 1.7 cm. broad, glabrous. Seeds immature.

Type in the U. S. National Herbarium, no. 571750, collected at Yaxcaba, Yucatán, Mexico, 1895, by G. F. Gaumer (no. 721).

According to a communication of Dr. Millspaugh, the fruits just described, which bear the no. 57934, were collected at a different place by Dr. Gaumer but referred to the above species, under no. 721.

The Maya name of these pods is "Kuxub-toooh," that of the type specimens "cibix."

8. *Dalbergia mexicana* Pittier, sp. nov.

Branchlets terete, finely striate, ferruginous-puberulous, glabrate.

Leaves 9 to 11-foliolate, the rachis terete, slender, sparsely ferruginous-pubescent, 5 to 7 cm. long. Leaflets subcoriaceous, the petiolules ferruginous-hairy, about 2 mm. long, the blades ovate, or sometimes suborbicular or obcordate, rounded at the base, rounded-emarginate at the apex, 1 to 4 cm. long, 1 to 2 cm. broad, dark green, lustrous, reticulate, glabrous or sparsely ferruginous, reticulate and sparsely pubescent beneath, the costa subimpressed on both faces, the veins prominulous above, obsolete beneath.

Inflorescences axillary, very short (not over 2 cm. long), few-branched, the ramifications subcymose, the rachis ferruginous-hairy. Bractlets ovate, acute, hairy, not over 0.5 mm. long. Flowers pedicellate, about 5 mm. long,

the pedicels hairy, 1 mm. long or less. Calyx cupulate, 2 to 3 mm. long, sparsely hairy at the base, more so on the lobules; vexillar lobules subacute and broad, lateral lobules small, acute, close to the carinal one and separated from the former by deep sinuses; carinal lobule subulate, twice as long as the vexillar ones. Petals glabrous; standard obovate, subbiauriculate at the base, slightly emarginate at the apex, the claw 1.2 mm. long, the blade 4.2 to 4.6 mm. long, 3 to 3.3 mm. broad; wings obovate, rounded-auriculate on the vexillar side, subauriculate on the carinal side, rounded at the apex, the claw 1.2 or 1.3 mm. long, the blade about 4 mm. long, 1.7 or 1.8 mm. broad; carinal petals obovate, auriculate on the vexillar side, rounded at the apex, the claw 1.3 to 1.5 mm. long, the blade about 3 mm. long, 1.5 mm. broad. Stamens 10, monodelphous, the tube open above, glabrous. Pistil 4.8 mm. long, the ovary minutely pubescent on the margins, 2 to 3-ovulate, the style arcuate, glabrous, the stigma inconspicuous.

Type in the John Donnell Smith Herbarium, collected in Mexico, without definite locality, by E. Kerber (no. 434).

9. *Dalbergia campecheana* Benth. Journ. Linn. Soc. 4: Suppl. 37. 1860.

TYPE LOCALITY: Campeche, Mexico.

SPECIMENS EXAMINED:

GUATEMALA: Aquascalientes, 1909, *Deam* 6125.

Mr. J. Donnell Smith identified these specimens with Bentham's above named species. This, however, seems to have larger leaves, with 7 to 19 almost sessile leaflets, while in *Deam's* specimens these are 9 to 11 and petiolulate. The other characters seem to agree.

10. *Dalbergia brownei* (Jacq.) Urban, Symb. Antill. 4: 295. 1905.

Amerimnon brownei Jacq. Enum. Pl. Carib. 27. 1760.

Dalbergia amerimum Benth. Journ. Linn. Soc. 4: Suppl. 36. 1860.

TYPE LOCALITY: Jamaica.

SPECIMENS EXAMINED:

VENEZUELA: Puerto Cabello, 1874, *Kuntze* 1721.

COLUMBIA: Negüangüe, on the coast between Santa Marta and Rio Hacha, 1898, *H. H. Smith* 1750. Dagua Valley, Cauca, altitude 25 meters, *Triana* 1130.

PANAMA: Providence Island, Bocas del Toro, 1885, *Hart* 182. Beach between Fató and Playa Damas, 1911, *Pittier* 3834. Rio Grande swamps, near Panama City, *Hayes*. La Palma, southern Darién, 1914, *Pittier* 6613. Coiba Island, *Seemann* 626.

COSTA RICA: Ceibo River near Buenos Aires, altitude 200 meters, 1892, *Tonduz* 6675. Santo Domingo de Osa, 1896, *Tonduz* 9892.

NICARAGUA: San Juan del Norte, 1895, *Pittier* 9658.

GUATEMALA: Boca del Polochic, Department Izabal, 1889, *J. D. Smith* 1708. Livingston, 1906, *von Tuerckeim* II. 1216.

MEXICO: Veracruz, 1910, *Adole* (?). Tampico, 1898, *Pringle* 5764, 6809. Rincón Antonio, Oaxaca, 1910, *Orcutt* 3263.

Several species may be included under this name. According to Bentham, it is a tree; *Tonduz* describes it as a shrub (*arbrisseau*); while *H. H. Smith* says it is a "twining plant, reaching 30 feet, with a prickly main stem and 2 inches or more in diameter." In my own notes, no. 3834 is described as "a shrubby vine, with white flowers," and no. 6613, as a small tree branching from

the base." The only fruits at hand differ a little from Bentham's description, and in Donnell Smith no. 1708, from Guatemala, I find the petals narrower, the standard auriculate, the ovary 5-ovulate and other small differences.

Although distinctly characteristic of the strand formation, *Dalbergia brownei* is sometimes found far above sea-level. H. H. Smith observed it, for instance, up to about 700 meters in Santa Marta.

11. *Dalbergia ecastophyllum* (L.) Taub. in Engl. & Prantl, Pflanzenfam. 3³: 335, 1894.

Hedysarum ecastophyllum L. Syst. ed. 10, 2: 1169. 1759.

Ecastophyllum brownei Pers. Syn. 2: 277. 1807.

TYPE LOCALITY: West Indies.

SPECIMENS EXAMINED:

TRINIDAD: Port of Spain, 1874, *Kuntze* 764.

VENEZUELA: Paparo, mouth of Rio Grande del Tuy, Barlovento, Miranda, 1913, *Pittier* 6349.

COLOMBIA: Santa Marta, 1914, *Sinclair*.

PANAMA: Chagres, 1854, *Fendler* 315. Colon, *Hayes* 155. Without definite locality, 1874, *Kuntze* 764.

COSTA RICA: Boca Banano, 1895, *Tonduz* 9156. Diquis River, 1891, *Tonduz* 4014. Punta Mala, in the Diquis delta, 1892, *Tonduz* 6775. Santo Domingo de Osa, 1896, *Tonduz* 9892.

GUATEMALA: Puerto Barrios, 1905, *Deam* 59.

HONDURAS: Puerto Sierra, 1903, *Wilson* 248. Ruatán Island, 1886, *Gaumer*.

BRITISH HONDURAS: Manatee Lagoon, 1906, *Peck* 463.

Dalbergia ecastophyllum has also been reported from many localities from Rio de Janeiro northwards and including the Guianas on the Atlantic seaboard of South America, from all over the West Indies, and from Florida. It is worthy of notice that this shrub does not seem to have been recorded from Mexico.

12. *Dalbergia monetaria* L. f. Suppl. 317. 1781.

TYPE LOCALITY: Surinam.

SPECIMENS EXAMINED:

FRENCH GUIANA: Karouany, *Sagot* 159.

VENEZUELA: Bosque de Catuche, above Caracas, 1913, *Pittier* 6297.

PANAMA: Rio Sirri, Trinidad Basin, province of Colón, near sea-level, 1911, *Pittier* 4029.

HONDURAS: Tela River, near Puerto Sierra, 1903, *Wilson*¹77. Laguna Quemada, Atlantic Coast, 1903, *Wilson* 627.

GUATEMALA: Puerto Barros, 1905, *Deam* 70.

This species is scarcer in Central America than either *D. brownei* or *D. ecastophyllum*. It does not figure in the Biologia Centrali-Americana, and, since the publication of this work, has been reported only from a few localities as shown above, all on the Atlantic seaboard, from Guatemala southeastwards. It is found also in the West Indies and on the eastern watershed of South America as far south as the Amazon basin. It penetrates far into the interior along the main rivers, and in the vicinity of Caracas reaches an altitude of about 1200 meters.

Unless it has been incorrectly stated, the habit of this species is very variable. Some report it as a shrub or small tree up to 3 meters high; Bentham³ says "caulis lignosus vulgo scandens;" and the notes corresponding to my no. 6297 from near Caracas are as follows: "a large vine, often 15 cm. in diam. at the base and climbing to the top of the highest trees." The shape of the fruit is also different in specimens from different localities, although I have never seen the oblong type reproduced in plate 63 of the work just cited. With reference to this plate it may be opportune to mention that although Bentham indicates only 9 stamens, as always found by myself, he gives two illustrations of the androecium of *D. monetaria*, each with 10 stamens.

13. *Dalbergia calycina* Benth. Journ. Linn. Soc. 4: Suppl. 35. 1860.

TYPE LOCALITY: Guatemala (*Friedrichsthal*).

14. *Dalbergia hypoleuca* Pittier, sp. nov.

Tree; young branchlets ferruginous-pubescent.

Leaves 7 to 11-foliolate, the rachis terete, pubescent, glabrescent, 10 to 20 cm. long. Leaflets coriaceous, often opposite or subopposite, the petiolules canaliculate, grayish-pubescent, 5 to 7 mm. long, the blades ovate or ovate-oblong, rounded at the base, obtuse and subretuse at the apex, 3 to 7 cm. long, 2 to 3 cm. broad, glabrous and finally reticulate with the venation prominulous above, beneath grayish or whitish, minutely pubescent, with the costa very prominent and the veins slightly so; margins strongly revolute.

Inflorescence axillary or terminal. Flowers not known.

Legume coriaceous, glabrous, long-stipitate, rounded-attenuate at the base, rounded and mucronulate at the apex, 1-seeded and then 8 cm. long and 2 cm. broad, or 2 to 5-seeded and up to about 16 cm. long, the breadth varying between 1.7 and 1 cm.

Type in the John Donnell Smith Herbarium, collected at El Escobal, near Atenas, Costa Rica, by Federico Golcher. Represented also in the U. S. National Herbarium (no. 716263) by the same collection, without date, and numbered 1747, which probably corresponds to the series of the Instituto físico-geográfico.

This is the Costa Rican *Cocobola*, equal in value to that of Panama, but even scarcer. It is probably a close relative of the latter, but the leaflets are less numerous, and the pods much narrower.

15. *Dalbergia granadillo* Pittier, sp. nov.

Tree. Leaves 7 to 13-foliolate, the rachis terete, at first pubescent, 9 to 17.5 cm. long. Leaflets submembranous, often subopposite, the petiolules sparsely pubescent or glabrescent, canaliculate, 4 to 5 mm. long, the blades suborbiculate or ovate, broadly rounded at the base, obtuse or subacuminate at the apex, 3 to 5.5 cm. long, 2 to 4 cm. broad, glabrous and reticulate with the venation prominulous above, glabrous except on the prominent, sparsely pubescent costa, and the veins prominulous, beneath; margins not revolute.

Inflorescence paniculate, axillary or terminal, the rachis few-branched, ferruginous-pubescent. Flowers few. Calyx cupulate, ferruginous-pubescent, persistent. Other floral details not known.

³ In Mart. Fl. Bras. 15: 229. 1862.

Legume lanceolate, long-stipitate, attenuate at the base, acute at the apex, glabrous, lustrous, 1-seeded and about 9 cm. long and 1.8 or 2 cm. broad, or 2 to 4-seeded and then up to 17.5 cm. long. Seeds oblong-reniform, not mature.

Type in the Gray Herbarium, collected at El Tibor, in the valley of the Balsas River (between the States of Guerrero and Michoacan), Mexico, August 22, 1898, by E. Langlassé (no. 294).

Like *D. retusa* and *D. hypoleuca*, this species furnishes a precious wood, which is hard, fine, and red-veined, and is known locally as *granadillo*.

The specimens at hand are hardly satisfactory for a description, but they belong to a section heretofore not known to be represented in Mexico, and differ from the other Middle American species of the group in the shape, consistence and indument of the leaflets, and in the shape and appearance of the pods. It is consequently pretty safe to consider them as corresponding to a type specifically distinct.

16. *Dalbergia retusa* Hemsl. Diagn. Pl. Nov. 1: 8. 1878.

TYPE LOCALITY: Paraiso, Panama (*Hayes* 642).

SPECIMENS EXAMINED:

PANAMA: Penonomé, Coclé, 1908, *Williams* 425. Chagres River above Alhajuela, 1911, *Pittier* 3511. Vicinity of La Palma, southern Darién, 1914, *Pittier* 6606.

COSTA RICA: Salinas Bay, between the littoral plain and La Cruz de Guanacaste, 1908, *Pittier* 2737.

This is the Panama "cocobola," a hard wood very well known commercially and obtained probably from several species of the same genus. I have seen no specimens from the type collection, but ours agree generally with the description. The leaflets, however, are more numerous and not usually retuse and the flowers seem to be smaller.

In Panama this tree has been exploited with such diligence as to have become very scarce in the central and western districts. In 1914 the more important logging camps were at Sumacate and Rio Congo in Darien.

17. *Dalbergia lineata* Pittier, sp. nov.

Large deciduous tree with rounded crown; young branchlets minutely fuliginous-pubescent.

Leaves 8 to 15-foliolate, the rachis 8 to 20 cm. long, more or less fuliginous-pubescent. Leaflets petiolulate, at first membranous, often opposite or subopposite, the petiolules grayish-hairy, about 7 mm. long, the blades ovate or oblong, cuneate or attenuate at the base, obtuse at the apex, 4 to 8 cm. long, 2 to 3.5 cm. broad, glabrous above, with the costa and veins prominent, densely grayish-pubescent beneath. Stipules ovate, acute, fuliginous-pubescent without, up to 7 mm. long and 3 mm. broad, very caducous.

Inflorescences paniculate, axillary or terminal, few-flowered, the rachis fuliginous-pubescent, 4 to 15 cm. long. Bracts and bractlets fuliginous-hairy, very caducous, the latter oblong, obtuse, not over 1 mm. long, inserted in pairs close to the calyx. Flowers about 16 mm. long, the pedicels densely fuliginous-hairy, about 3 mm. long. Calyx cupulate, 5 to 6 mm. long, densely pubescent, the vexillar lobes broader, equal in length to the lateral ones, the

carinal lobe linear-apiculate and longer. Petals white, delicately purple-lined, glabrous; standard strongly reflexed, ovate, attenuate at the base, emarginate at the apex, the claw 3 mm. long, the blade 10 mm. long, 8.5 mm. broad; wings obovate, oblique, auriculate on the vexillar side, the claw 3.5 mm. long, the blade 11.5 mm. long, 4.5 mm. broad; carinal petals falcate, auriculate on the vexillar side, obtuse at the apex, the claw as in the wings, the blade about 10 mm. long, 4 mm. broad. Stamens 10, monadelphous, alternately long and short. Pistil about 13 mm. long, glabrous, the ovary long-stipitate, linear, 4 to 6-ovulate; style strongly arcuate; stigma capitate, inconspicuous.

Type in the U. S. National Herbarium, no. 577918, collected at Nicoya, Costa Rica, April, 1900, by A. Tonduz (no. 13969).

A specimen (Inst. fis.-geogr. n. 13887), obtained by the same collector from the forest of Nicoya, is probably the same species. However, the specimens are leafless and floral panicles larger and many-flowered. Mr. Tonduz says that the tree they proceed from is a preponderant one in the forests of the peninsula, being gregarious and giving a characteristic bluish-gray color to the forests in April, the flowering time.

The affinities of this species are evidently with *Dalbergia retusa* Hemsley.

ELECTRICITY.—*Electromotive force of cells at low temperatures.*¹

G. W. VINAL AND F. W. ALTRUP, Bureau of Standards.

The practical importance of a knowledge of the electromotive behavior of dry cells and storage batteries at low temperatures has arisen from their use in the Arctic and at high altitudes. In June, 1921 the Department of Terrestrial Magnetism of the Carnegie Institution, of Washington, through Dr. S. J. Mauchly, requested the Bureau of Standards to furnish information in answer to the following questions: (a) What is the open circuit voltage of dry cells at approximately 0° Fahrenheit and below? (b) Are dry cells fit for use after they have been frozen and thawed out again? Since there was no reliable information available on this subject, experimental work was undertaken which included observations on storage batteries also. In the first experiment the temperature range was extended to -72° C. and as the open circuit voltage of the cells was not materially changed by cooling them to this temperature, the work was extended to -170° C. because of the theoretical interest in the application of the Gibbs-Helmholtz and Nernst equations to these cells.

Two methods of cooling the cells were employed. For the range +25° to -72° C., the cells were submerged in a gasoline bath to which small amounts of carbon dioxide snow were added gradually until the

¹ Published by permission of the Director of the Bureau of Standards. Received January 6, 1922.